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Hot Iron

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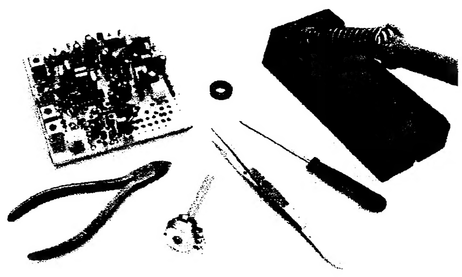
Editorial



Mid August and the sun is out. The corn is ripening and my mind is in neutral owing to the heat! I take my notebook out into the garden to try and have a (any!) new idea for something interesting but end up asleep! The snag is really that once one has developed a few direct conversion rigs and then done mutli-band superhets; its quite difficult to improve their performance without causing the cost to increase significantly. I am acutely aware that cost is pretty important for most people but there is a small sector, who having built cheaper rigs which prove to be a bit lacking in some department, realise that good performance does cost appreciably more. My aim therefore is to give good value for whatever builders decide to spend - apart from a few dodges in the circuitry, it often comes down to being mean on the mechanical things! I think cases are poor value for money because they are seldom essential. If you wish to take it up a mountain, then yes - go for a case and many other aspects that would be found in a military radio, but you will end up paying! All of this is a way of saying I need some ideas for what would interest you next! What about ancillaries - which ones? Tim

Kit Developments

Last time I mentioned the new '**K**' family! They are for novice builders and those taking their exams! The parent is the **Kilve** DC receiver! It is for any single band 20 to 80m - it can even do 5 MHz if needed! It has three JFETs for the RF stages and three BS170 MOSFETs for the audio part. Its intended to drive walkman type phones and has just one control - the PolyVaricon tuning! As cost is strongly influenced by size, it is a single sided small PCB of just 50 x 80 mm. The single set of parts is suitable for any of the bands 20 to 80m. The price is £19 with £2 for P&P.

There are two 'matching' 1.5 W transmitters, both on 50 x 80 mm double sided PCBs and both designed for stand alone use. Both have their own oscillator which is supplied with an 80m ceramic resonator and trimmer which will give roughly 75 KHz of tuning range on 80m; for the higher bands (up to 20m) you need a crystal or an external VFO scheme to avoid the problems of chirp or 'FMing'. The **Kilton** is the CW transmitter and the **Kilmot** is the double sideband phone transmitter. Their prices are £19 and £24 respectively. Ordered with the RX you save on the postage and get a TR relay too! Later some of these will be featured in Practical Wireless, hence only brief details now. I hope Rob M wont mind me including a photo! Tim Walford G3PCJ

Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £7 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics— principally on amateur radio related topics– is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

The EP Antenna

David Buddery G3OEP has sent in this note but I am not sure if he designed it or what EP stands for! No matter - it's a very interesting approach! He says it was designed by an elderly Ham as an inexpensive yet efficient all band antenna suitable for portable use or a small garden. Tim

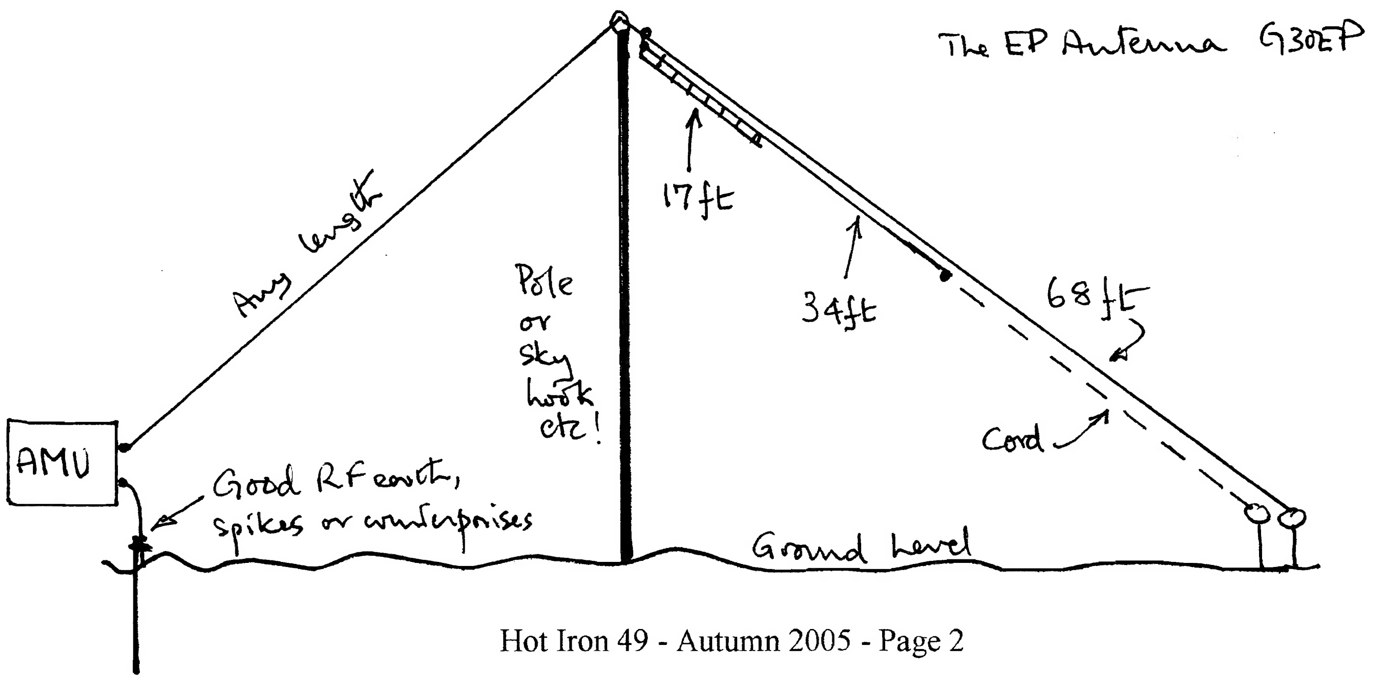
Design Principles

The EP antenna is an attempt to load any wire without using coils or traps such that its highest point corresponds to a current node. The basic design of the antenna depends upon the fact that in any end fed wire antenna, a current maximum (a node) is found at every ODD quarter wave. Hence for a wire one quarter wave long, there will be a note at the feed point; however if it is three quarter waves long, there will be two current nodes - one at the feed point and another a further half wave along the wire. Most antenna experts agree that the majority of the radiation comes from the current nodes so an objective should be to get these high. (If you don't agree with these suggestions, then this antenna is not for you!) The only disadvantage of the EP antenna is that is MUST tuned against a GOOD RF earth.

So how was the device developed? Consider a quarter wave length of wire supported at one end, the lower end being at an angle to the ground. The upper end will present a current node to any wire connected to it, ie there will be a current node at the top of any feeder wire connected to the quarter wave wire irrespective of the feeder length. The impedance at the AMU end will be very different though - varying with band and feeder length!

Physically, I took a 17 ft length of slotted 300 Ohm feeder cable and at one end (the top end), soldered both conductors together; to the far end of one conductor, I joined a further 17 ft of wire, while carefully insulating the unconnected other conductor of the 300 Ohm feeder. Now I had one conductor 34 ft long which is a quarter wave on 7 MHz and three quarter waves on 21 MHz. The other conductor of 17 ft is a quarter wave on 14 MHz. I now took a 68 ft length of wire and soldered it to the top end of the 300 Ohm feeder, thus presenting a quarter wavelength and a current node at the conjoined top of the set up for 3.5 MHz. Hence I had current nodes on 21, 14, 7 & 3.5 MHz at the top of the device and ANY feeder wire connected at the top will be presented a low impedance current node on all these bands. The other wires, which are not quarter waves for the band in use, will have a much higher impedance in parallel so will not materially alter the low impedance presented by the active quarter wave wire. The mode of construction means that there will be but two lengths of wire suspended form the support; indeed, if the 7 MHz wire is secured by a good insulator to the 3.5 MHz wire, then only one wire will need to be attached to the distant support - see below.

I have said that the feeder, which is part of the radiating system, can be any length, though for best results on the lower frequencies length under 45 ft do not secure ideal conditions. A good versatile Aerial Matching Unit is essential together with an effective RF earth system, possibly several ground stakes, or a set of counterpoises (each a quarter wave long) for the bands in use.



Transmitter Controller - by Eric Godfrey G3GC

Whether one uses high power, low power, professional or home brew transmitters it is always wise to soak test them for quite long periods such as might be required in contests. To help test transmitters under these rigorous conditions I made a transmitter controller to simulate these conditions. The controller is assembled on the lid of a die cast aluminium box measuring 12 x 6 x 4.5 cms, operates from its own internal 9 Volt battery and provides two transmitter test facilities when plugged into the key socket of a transmitter:-

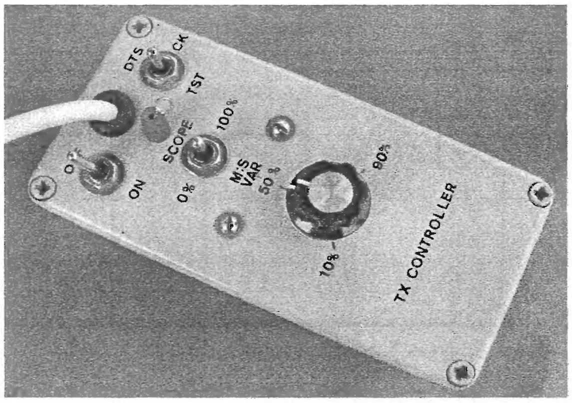
(1) To automatically key the transmitter with variable duty cycles from around 5% to 95%, together with two fixed duty cycles of 0 % (transmitter off) and 100 % (transmitter on).

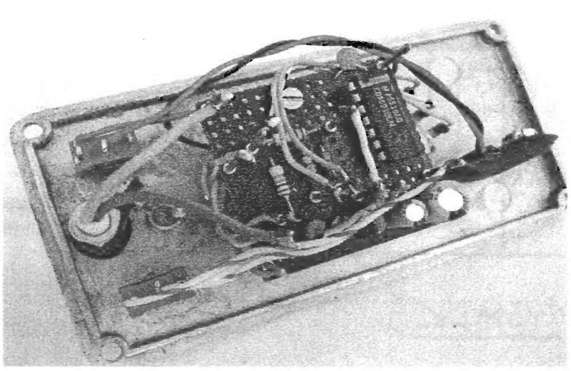
It is quite often unknown how a transmitter will stand up to continuous use over a long period of time such as field days, contests etc and I expect that you have all heard some of the poor quality signals at the end of field days. These conditions can be simulated by connecting the transmitter to a dummy load, turning the power up to maximum and then use this controller to continuously key the transmitter with various duty cycles over hours or even days. This will provide a good indication as to whether there is likely to be any problems with overheating, drifting, etc and also, by listening on a separate receiver, if there is any deterioration in signal quality. Although this device is in effect testing in CW it is quite satisfactory to go over to SSB during the test period to check the quality in the SSB mode as well as CW.

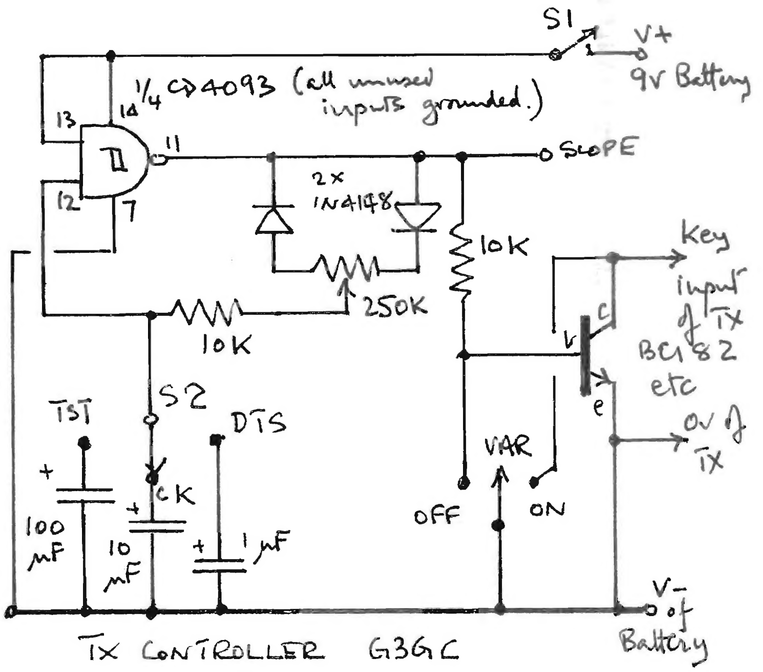
(2) To provide a continuous series of dots at around 17 wpm.

This is useful for identifying the transmitter's harmonics and/or any other unwanted birdies when listening on a general coverage receiver.

The basic circuit is simply an A-stable Nand Schmitt Trigger connected to a switching transistor to key the transmitter. The jack plug, which is connected between the transistor's open collector and ground, simply plugs into the key socket of any transmitter that has a positive control line. This positive control line may be anything up to about 15 Volts which is universal in professional equipment these days. In the circuit diagram, where S1 is the battery on/off switch, the repetition frequency of the A-stable is dependent upon the position of S2 selecting one of three different capacitors, giving three 'speed' ranges covering 4 cycles per minute to about 17 words per minute of dots. The proportion of each cycle in which the 'key' is up or down are also adjustable owing to the different rise/fall time constants, as selected by the two diodes and their section of the potentiometer. In mid position the key down and up times will be equal. The output for a scope is useful for triggering the display to show the RF envelope. S3 allows the controller to run, or be stopped or the 'key' kept down continuously. Eric Godfrey, G3GC







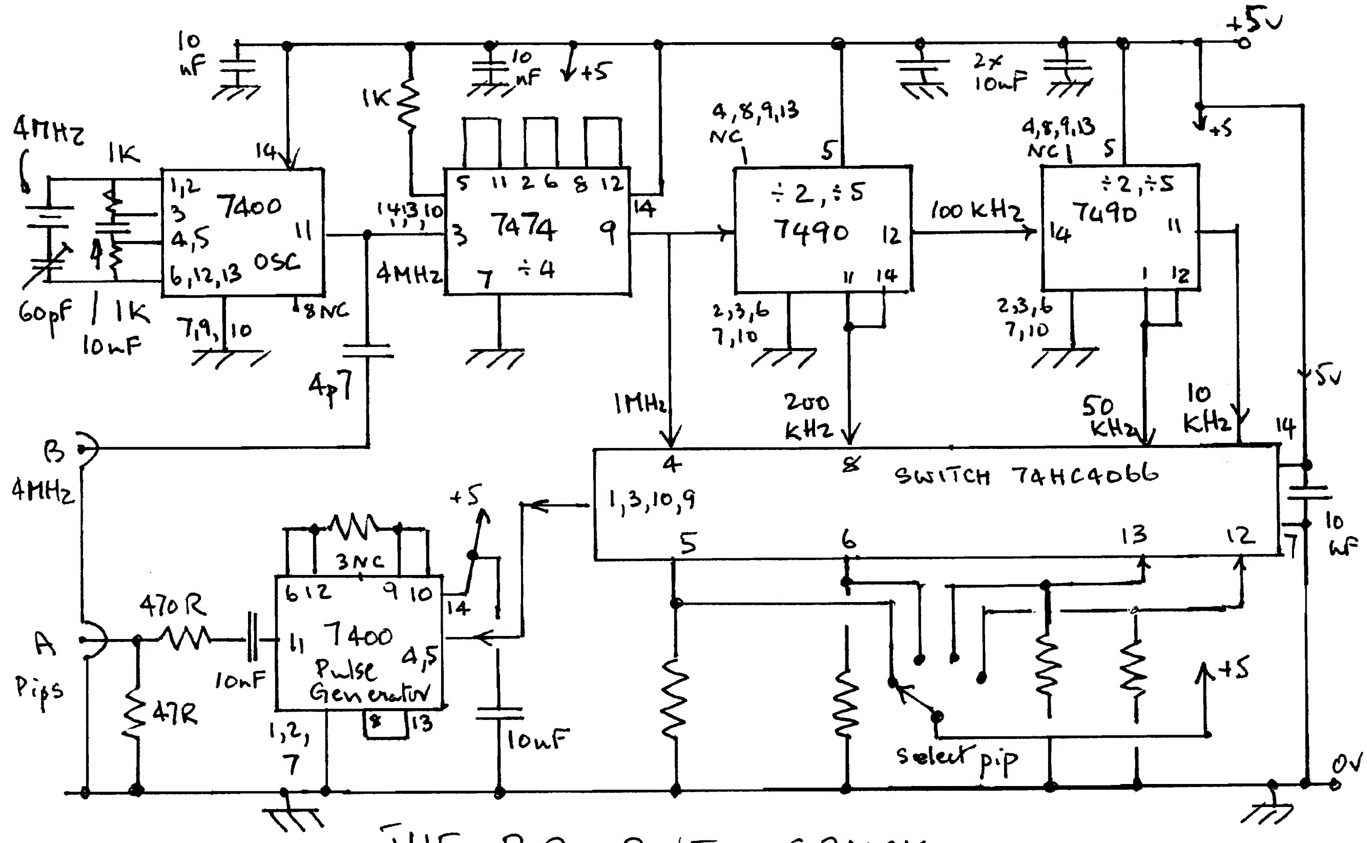
The Porcupine - so called because it has so many spikes! By Gerald Stancey G3MCK

(The original was written for the Vintage Military & ARS Newsletter, to whom I am most grateful for permission to publish. Due to lack of space I have had to edit it down heavily - my apologies. Tim)

Those of us who enjoy using classic receivers know the value of having a crystal calibrator for establishing band edges and for accurately calibrating the logging scale. Many handbooks give circuits using 74 series chips and this note explains how the utility of such circuits can be extended.

I have often found that 10:1 frequency ratio between pips is too large and that counting 10 KHz ones is not easy either! At times I have even not been too sure of the 1 MHz pips! The '7490' decade divider chip has separate divide by 2 and 5 stages making it possible to obtain 1 MHz, 500, 200, 100, 50, 20 or 10 KHz pips easily depending on your chosen crystal frequency. I choose 1 MHz, 200, 50 and 10 KHz pips derived from a 4 MHz oscillator. It is sometimes useful to have other discrete frequencies such as 3560 or 3500 KHz which will give pips at their harmonics on all bands upwards. For receiver alignment purposes, having the output impedance at 50 Ohms is desirable and is easily achieved by adding a 50R output impedance attenuator. It is also handy if the amplitude of each pip (for a given fundamental frequency) is the same; this is easily done by using a pulse generator of the type given by Ian Braithwaite in his excellent Radcom article in June 1998. If the output depends on just the harmonic content of the selected fundamental, which may not even be a square wave, then odd and even harmonics will not have the same amplitude. Another bonus of this circuit is that the difference in amplitude between pips of different fundamentals is easily calculated - it is 20 times the log of the ratio of their frequencies. For example, in this calibrator, the difference in amplitude of the 50 KHz pips compared to the 10 KHz pips will be 14 dB.

All of the above features are present in my calibrator which uses a 74HC4066 chip to select the fundamental that is fed to the pulse generator. If you try a rotary switch, you may have too much leakage affecting the pip amplitudes. I know because I tried it! Because the 4066 has only four 'switches' I provided a separate 4 MHz output whose amplitude cannot be directly related to those from the spike generator. A spectrum analyser showed that all pips of each fundamental were within +/- 1 dB across the HF spectrum and I see no reason why similar results would not be obtained by anyone who makes this unit. The measured levels were: 1 MHz fundamental pips @ -37 dBm, 200 KHz pips @ –51 dBm, 50 KHz pips @ - 63 dBm and 10 KHz pips @ -75 dBm.



THE PORCUPINE - G3MCK

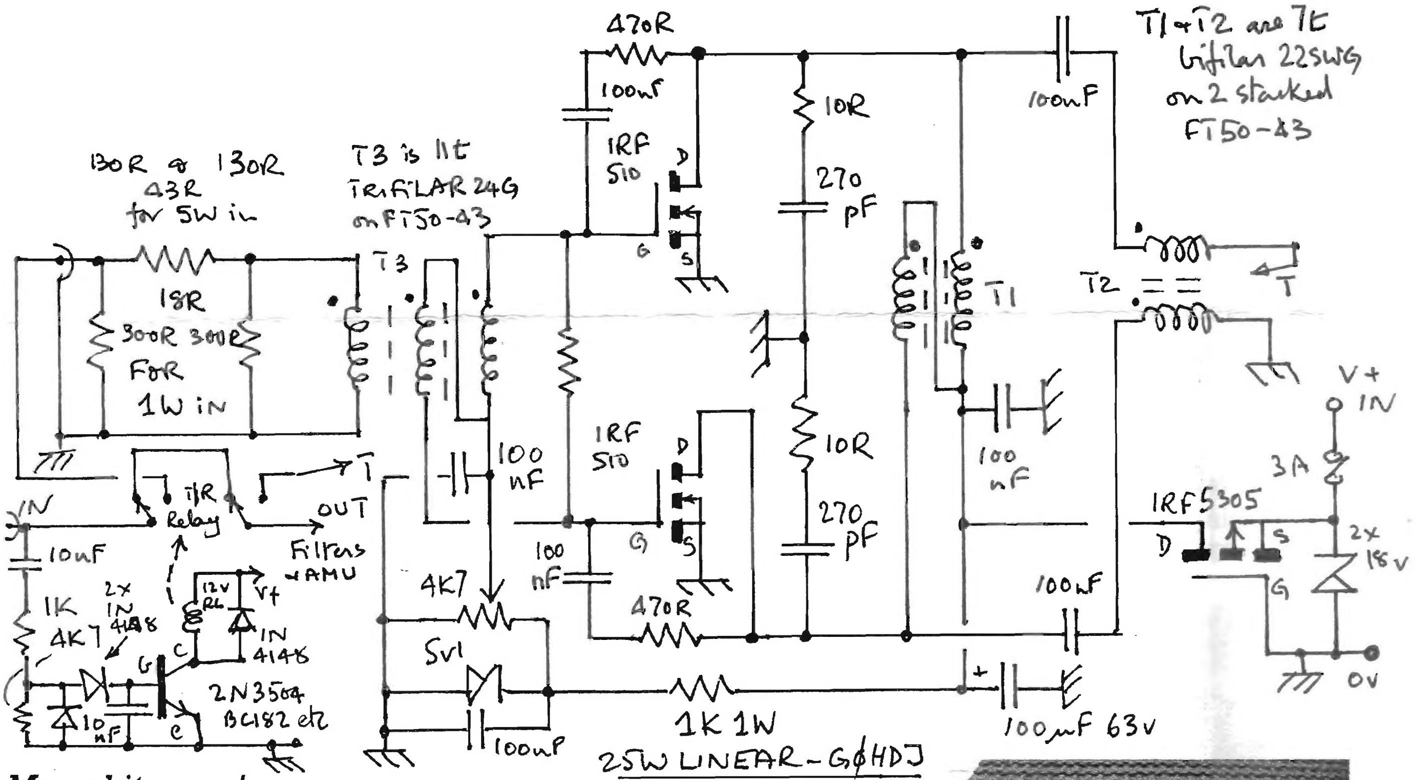
HF Linear amplifier by Craig Douglas G0HDJ

This circuit is certainly not original and the main part comes from 'Radio projects for the Amateur' by Drew Diamond VK3XU, a 25W MOSFET Linear, which he states is for 1.8 to 7 MHz but useable to 14 MHz. The input power is nominally 1W and the output 25-30W with a 25 volt supply.

The antenna switching circuit came from an article by Mike Kossar WA2EBY, 'A broadband HF amplifier using low cost MOSFETs (QST Mar 1999). His amplifier looked good but required a few more parts so I opted for the easier one on the KISS principle. The output is fed into 7 element Chebyshev filters based on designs by Stefan Niewiadomski published in PW in Feb 2005 which I have put into a separate box for greater flexibility.

The input attenuators are also switched between two designs for either 1 or 5 Watt input so that I can use it with a variety of TCVRs. Into a dummy load, my scope shows an ether disturbing 9W from a 4W input on 13.8 volts - well its serious QRO for me anyway! Drew gives a few construction requirements and a layout diagram in the above book which I can copy if required. The circuit also has reverse supply protection because the MOSFETs look like diodes across the supply if it is connected the wrong way round and they will conduct many Amps!

(This Linear is very similar in concept to my HF Linear kit but it does not have some of the extras that Craig has incorporated. Increasing the supply voltage on Craig's to the design 24 volt level should lead a big increase in maximum output level - theoretically x4 - not quite so much practically due to the 'on resistance' of the MOSFETs. Tim.)



More kit news!

I shall shortly be retiring the Bristol and Locking - mainly because some of the parts required are no longer made/available!

I have just, or will soon have, laid out the PCBs for several new accessory kits. They are a new relay selected dual low pass filter kit for TXs, a relay selected dual RF bandpass filter kit (50R in with 50R or 1K5 out) - both any bands 20 to 80m. I am doing a new versions of the RF signal generator, the two tone audio oscillator (or sig gen) and harmonic marker generator which will provide pips based on fundamentals of 5, 2.5, 1 MHz, 500, 250, 100, 50, 25 or 10 KHz.

Question - who owns the car pictured right with number plate AY599? Answer on the back page! More on that maybe next time.

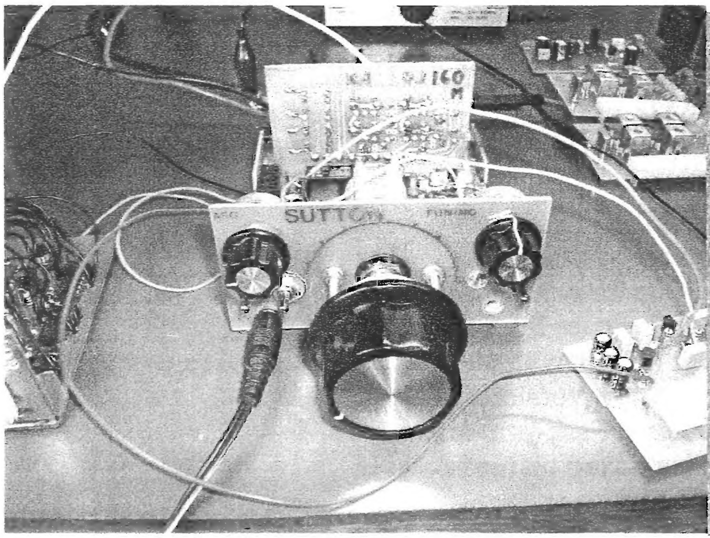
Crystal Filters and the Sutton - by Andy Howgate G7WHM

First off this is not an in depth technical article but more a simple experimenter's observations to assist the removal of BCI in the humble direct conversion receiver. Having built the Sutton RX and trying this receiver using several band cards as ever BCI can be a problem particularly so with 40m and 20m this is of course a common problem with this type of receiver at certain times of the day.

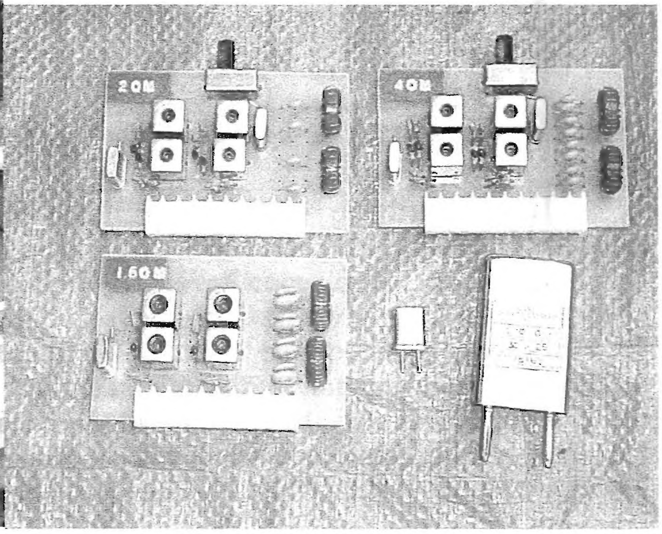
It became in my case, a quest to minimise the affects and since I wished to use this RX with the Mallet transmitter for the CW mode of operation in and around the QRP calling frequency. Having done some reading and web searching I came across an application where a crystal can be used ahead of the BPF to add some selectivity at the expense of sensitivity so having got into experimenting mode I applied a 7.030 MHz crystal to the front end during a period of heavy BCI and noted a dramatic improvement. I was so impressed I actually added the crystal to the band card but also included a switch so that the crystal could be shorted out so giving the benefits of reduced sensitivity but high attenuation to BCI when the switch was open and at other times the switch being closed restored the rig to using the BPF only. I would like to point out that this rig did have the Meter kit installed which provides some extra gain and AGC action.

Applying the same thought to the 20m band card I added a crystal for 14.060 MHz and duly noted the same attributes but obviously on both bands the further you move the tuning away from the marked crystal frequency the more attenuation occurs but the rig had become far more useable and more gentle on the ears with the AGC of the meter kit helping to compensate for the loss in sensitivity. Thinking further I thought I would try another crystal in parallel but in this case the only crystal frequency available was on 7.070 MHz – the affects were most interesting and over all it was possible to gain 1 S point in signal strength across a tuning range of 100 KHz or so but noted a peak signal strength at each marked frequency. Applying two crystals of the same frequency value will also raise an extra S point.

I think it fair to say that a receiver would need to be fairly sensitive if applying this technique and it may not suit all types of receiver, however if a receiver was to be designed using a crystal as part of its front end then the possibilities could be of major benefit. Included here are some photographs some of which for amusement and some to display the crystals as fitted to the band cards with the switch. I should also be most interested if anyone else may have knowledge of this application and improvements. During my enquiries, a friend of mine had knowledge of crystals being used as front end filters mostly on fixed frequency military equipment and I have also found one kit maker in the USA using a crystal as a filter element in a simple minimalist CW transceiver. The final transceiver here, when completed, will have 4 band capability via the band cards 160m to 20m and I plan using 160m on Am as well as using CW whilst the other bands will be used mostly at or close to the QRP frequencies. Andy Howgate G7WHM



Sutton with air variable tuning
Andy Howgate G7WHM



Sutton band cards with extra crystals

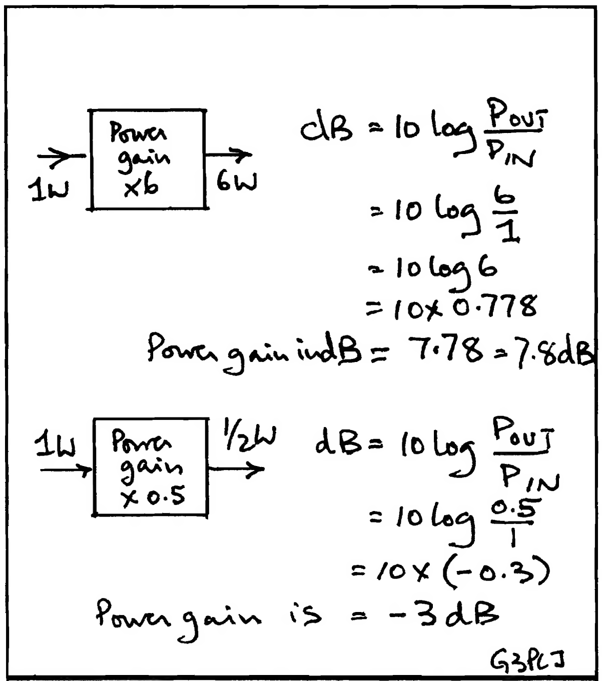
Theory - decibels

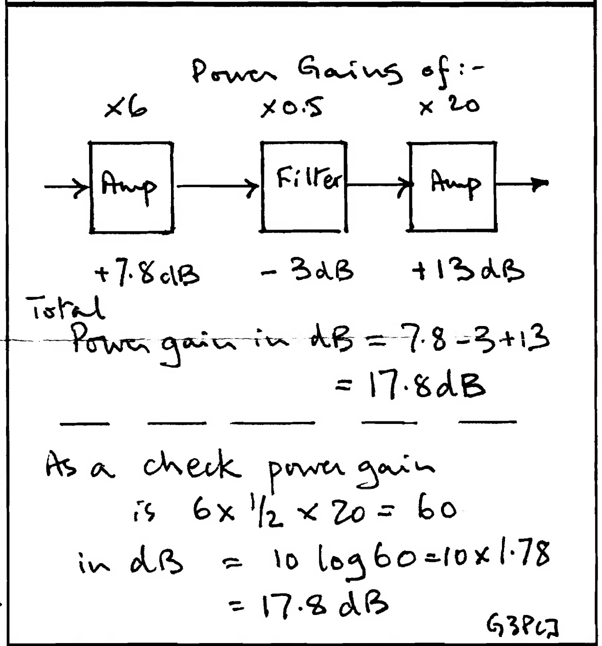
Many people feel very nervous of these strange 'units' but they were invented to make life much easier; especially when considering the progress of signals through some form of processing chain such as a receiver. THE most important thing to remember is that they are relative measurements - that it to say something is x dB greater than another, or if it is less than the other it is minus y dB written as - y dB.

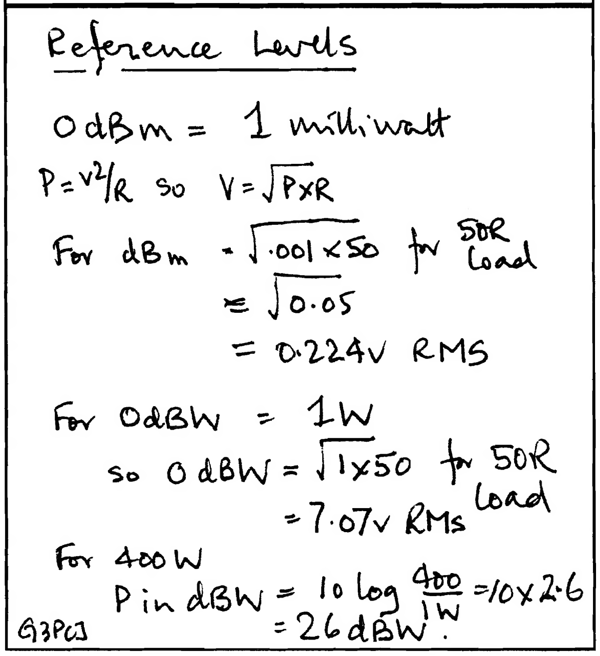
For RF work, it is common for the two quantities to be measured as power since one is often concerned about extracting, or not wasting, power. You need a scientific calculator to work out the Power gain in decibels, because the answer is 10 times the log of the ratio of the two power figures. This is explained in the box right where an input signal is one watt and after processing of some sort it emerges as 6 watts, giving a power gain of 7.8 dB. If instead it had emerged with a power of only half a watt, then the power gain would be minus 3 dB or - 3 dB.

If now the signal is processed through several boxes that might have gain or attenuation, the advantage of using decibels will become apparent. For example if there were three boxes with power gains of 6, 0.5 and 20, one would calculate the overall power gain as 6 x 0.5 x 20 = 60. However it is much easier to ADD up the gain expressed as decibels which becomes 7.8 +(-3) + 13 = 17.8 dB. As a check that this is correct, the log of 60 is 1.78 which multiplied by 10 gives the same answer of 17.8 dB. These examples are really rather trivial but if the signal processing is much more complex with several processes, doing the sums by direct multiplication is cumbersome - it is much easier to add up the stage gains in decibels taking account of any minus signs which imply that the process is reducing the power level through that box. This is especially true of switched attenuators that often form part of some test set up - the dBs of the many switches that are set to attenuate are just added together to give Z dBs of attenuation. If now the input power is known to be say 1 milliwatt, then the output of the attenuators will be Z dB below 1 milliwatt.

For convenience, certain power levels are commonly used as references, the receiver RF work the level of 1 milliwatt is often used and is known as 0 dBm, where the m designates the milliwatt aspect, thus the output of the attenuators above would be said to be - Z dBm. Consider another example - your licence states that certain bands have output power limits of 26 dBW, in this case meaning 26 dB above 0 dBW or one Watt; if you work the formula backwards, 26 divided by 10 = 2.6 which when 'anti-logged' on your calculator comes out at 398 - near enough to the commonly known level of 400 Watts! It is important to know whether you are dealing with dBs of *power* 'gain' because they can also be used for voltage gain - see next time. G3PCJ







Snippets!

Godfrey Manning offers a couple of comments:-

Low voltage valves He suggests these are often ordinary valves selected for better low voltage performance and not specifically designed for this use - hence their performance tends to be rather dismal, especially in a power handling sense. He has acquired 1960 Ford car radio which has valves (using 12 volt HT) for the RF stages but with an OC26 for the audio output stage!

Godfrey has also sent me an article on an *antenna rotator controller* that he has designed using stepper motors. I regret it's a bit long and complex to include in Hot Iron but I should be very happy to put any member in touch if they are interested. It involves 6 integrated circuits which are mostly CMOS 4000 series devices. It features continuous automatic stepping at speeds ranging from one step per 2 seconds to way beyond the abilities of most motors! He strongly advises a thorough soak testing of any second hand stepper before committing it to a major project!

Static Inverters Having been messing about with a photovoltaic solar panel, which is used to charge 12 volt lead acid batteries, I hope to be able to use this power source for more everyday loads that would normally be using the mains. Hence I have been contemplating a static inverter design. To be any real use, it has to have a waveform that is closer to a sine wave than the very simple square wave types! With a little digital logic and watty MOSFETs that is not too hard. Any interest? About £20, with your mains transformer (secondary 9-0-9v) and some heatsink metalwork. Tim

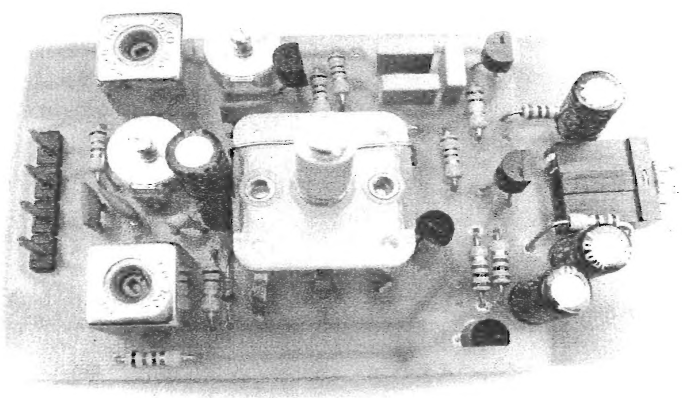
(The very next day after writing this, I had to use mine in anger! Clashing overhead lines in trees took us out! My commercial one would not start the fridge but it did keep the gas AGA alight!)

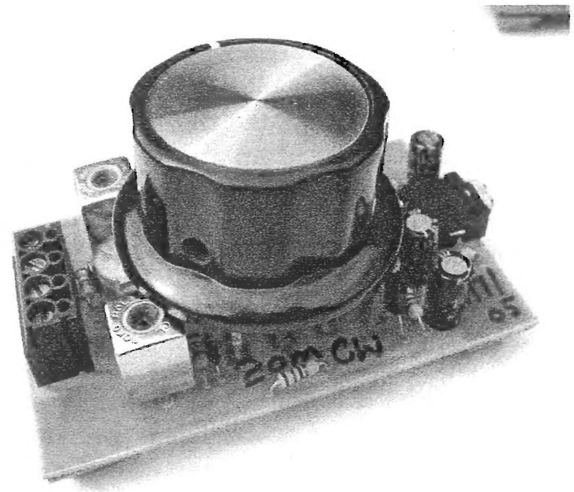
Request for help

My name is John Windybank, I am a novice at kit building. With help from Tim I managed to put together the Catcott RX, ATU, and Dundon TX. I had 2 QSOs on 40m and decided I needed greater selectivity in the RX. I eventually bought the Brent TCVR kit. I have commenced the very first connections and know it will not be a quick job for me. Although Tim is ready to advise constructors I thought it would be good to discover fellow Brent constructors who are able to give advice when and if required on:- Frequency counters, Scope divide by 10 probes, Dummy loads, Power meters and the alignment of Brent RX RF filters when those stages are reached. If any constructor could advise on these matters my telephone No is 01462 681796 or
e mail johnwindebank@amserve.com

Supercaps!

Members may recall that I mentioned that it was now possible to obtain capacitors with values of several Farads. The recent crash of an A300 series aircraft in Canada drew my attention to a press release about such capacitors. They are used to provide emergency power for the door locking actuators in these aircraft! Apparently each door has its own set of capacitors and they store sufficient power for up to 8 hours in standby and then be able to release the catches. Ultra capacitors are said to be more reliable and lighter than conventional batteries. I was delighted to note how well the escape arrangements worked in that particular incident - a very quick evacuation without loss of life.





Kilve RX - with & without knob!